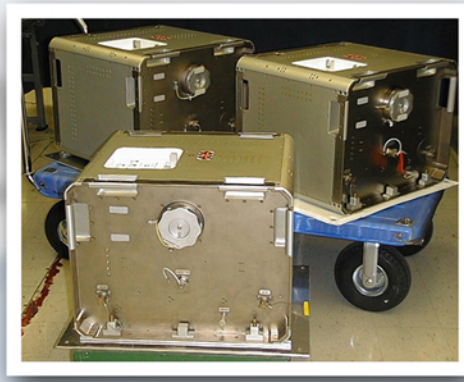
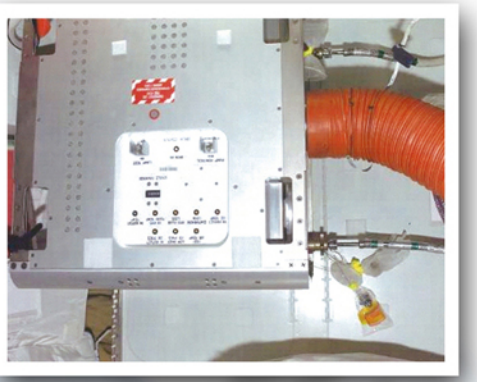
Innovation @ WSTF 2011

Oxygen Recharge Compressor Assembly (ORCA)





In 1997, WSTF accepted the challenge to design and build its first space-qualified flight hardware, the Oxygen Recharge Compressor Assembly (ORCA). ORCA would be used to transfer gaseous oxygen from space shuttle orbiters docked to the International Space Station (ISS) to a tank in the ISS Quest Joint Airlock. Virtually every department on site contributed to the ORCA project. Three compressors were built and acceptance tested and all three units transferred oxygen to the ISS. (As of April 2011, compressor assembly serial number 1001 is on orbit.) More than 800 lbm of oxygen was transferred over the course of 12 shuttle missions. There were no failures.

The ORCA design incorporated several innovations:

- WSTF worked with the motor supplier (Moog Inc.) to develop a direct drive motor that required no gearbox for speed reduction and met all acoustic emissions requirements. (The originally proposed combination of a high-speed motor and gearbox was extremely noisy.)
- ORCA incorporated an air-hydraulic reservoir that used inlet oxygen pressure to maintain proper hydraulic oil flow in a zero-gravity environment.
- The need for cam return springs or a much more complex double-acting cam configuration was eliminated by using the air-hydraulic reservoir to provide the motive force for piston return.
- The multi-layer diaphragm configuration incorporated an innovative method of mechanically setting the gasket leakage flow threshold for ORCA shutdown in the event of diaphragm failure.
- A simplified operator interface and self-safing system eliminated the need for any control or interaction from the ground.